



Electronic bus terminals in automobile parking systems

Field bus power in Smart Tower

Otto Nußbaum GmbH & Co. KG, of Kehl-Bodersweier, manufacture high quality lifting equipment, are exploiting the electronic bus terminals from Beckhoff, of Verl, in their latest car parking system for the Smart. The Nußbaum engineers are using the bus-independent terminals to implement efficient, CAN-based control solutions for the Smart Tower. The value to the customer: The hydraulic transport procedure takes only 2.5 minutes from searching to driving out.

It is not only its remarkable vehicle concept that has attracted attention since the Smart came onto the market. At 80 Smart centres in Europe, the three versions of the "micro compact car" – or mcc – have been presented to customers in a spectacular fashion. Just as innovative as the vehicles themselves are the fully automatic parking systems, developed specially for the mcc, the glass Smart Towers. They provide space for 27-35 Smart cars on several levels. And it is Beckhoff field bus couplers and bus terminals that convey the sensor signals for the presence and position of vehicles via CAN to the supervising PC controller to ensure problem-free, fully automatic positioning operation.

Parking by touch screen operation

The same maxim applies to both the vehicle and to the parking system: visually attractive appearance,

simple operation and functionally secure operation. For this reason the Smart Tower, developed by Nußbaum Automobile Parking Systems (Nußbaum Autoparksysteme) and Hayek Engineering, is based on an entirely new concept, one which is breaking new ground for warehouse and parking system technology. On each of the seven floors – eight or nine floors are available as a special version – are four parking places with dimensions of 4.3 metres long and 1.9 metres wide. The ground floor is an exception, where only three parking bays are available; the fourth must be dedicated to the vehicle hand-over and pick-up bay. The parking places are fed by means of a lifting cylinder elevator system with hydraulic telescope. This "shuttle" is the central lifting and functional element. It functions as the parking platform in the hand-over station, and combines

the turning and telescoping functions required for placement and removal of the vehicles at the correct floors and bays. The Smart's driver places his vehicle on the shuttle. Once green signal lamps indicate that the vehicle is correctly positioned, he gets out and starts the automatic parking procedure with the aid of a touch screen that, for reasons of safety, is mounted outside the tower. By touching the "IN" box the current occupancy on the park is graphically displayed. A desired park level can also be selected. The screen displays the current occupancy of the bays, and invites the desired free parking bay to be touched on the screen. The vehicle is transported to this parking location in the Smart Tower, and pushed into the parking bay there. Vehicles are removed according to the corresponding sequence, but in reverse.

Each of the four parking bays on the levels in the Smart Tower is angled at 90° to the next. For this reason, the correctness of the telescope position and the targeted parking bay must be determined before starting a parking or removal operation.



The Smart vehicles are stored behind a full glass facade on the small ground area of only 67.24 m². Its attractive design makes the Smart Tower into two things at once: an intelligent storage system and an effective presentation area for sales.

The emphasis is on safety and space-saving. Altogether 27 vehicles can be both stored and presented behind glass, using a minimum of space, in this way. The average duration of a parking or removal procedure is only about 2.5 minutes. Inductive sensors and photocells provide extensive checks on presence and monitoring of position. Their signals are conveyed via CAN to the control computer by the electronic field bus terminals, to provide the necessary control information.

All the procedures that take place in the Smart Tower are controlled by an Industrial PC with Pentium processor and CAN bus interface card. The control technology includes not only the sensors, initiators, photocells and operating panel, but also the control software. It regulates the individual procedures for placement and removal. The IPC individually controls all the movements in the equipment. In practice this means that all the set positions are supplied to the axis controllers of the lift and of the telescope, and that the PC then waits for their execution. The shuttle's axis controller is connected through one of the two serial interfaces.

The lift's controllers then convert the set positions into regulated

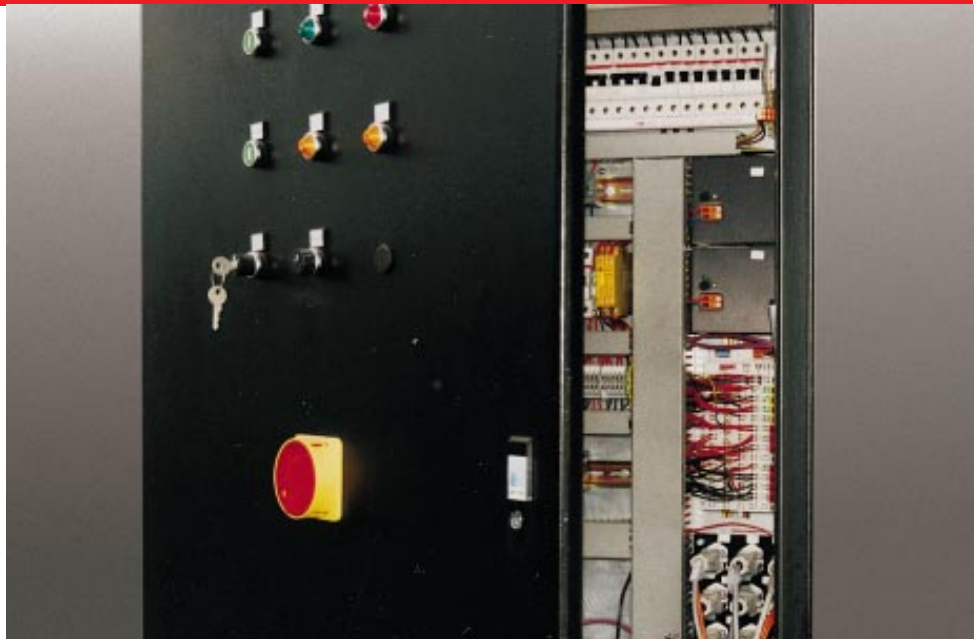
quantities for the hydraulic valves, thus causing the hydraulic cylinders to move. The data is exchanged with the peripheral components via the electronic field bus terminals over the CAN bus.

This underlines the advantage of the twin-channel field bus terminals from Beckhoff over 4, 8 or even 16 channel versions available on the market. Too inflexible and bulky, said the Nußbaum engineers. It is precisely the small size of the individual items that reduces space requirements in the switching cabinet. This is mounted in the central entrance area, and for architectural reasons needs to be kept as small as possible. The allocation, moreover, of one terminal per sensor brings prices down and reduces the liability to faults.

The configuration of the bus terminals is also easy. In a purely digital application, as is the Smart Tower, the pre-set standard terminals do not have to be specially configured, but are simply chained as a terminal block. In this way a variety of sensor products form an integrated system family. The following movements in the Smart Tower are registered by sensors:

- Real-time registration of the position of the 4 lift cylinders with the Nußbaum axis

Four hydraulic lift cylinders in the four main supports of the Smart Tower move the shuttle vertically, i.e. upwards and downwards. Each lift cylinder has a displacement sensor, which records the distance covered by the piston rod by means of an incremental transducer in the frictional wheel, passing it through the field bus terminals to the controlling PC.



controller-ROTAMES distance measuring system,

- Detection of the shuttle load state,
- Supervision of the correct telescope arm orientation towards the target bays,
- Avoidance of collisions between the shuttle telescope and the parts of the building,
- Determination of the zero-position of the parking platform,
- Limit switch-off and control of the turntable.

Integrated system family

The bus terminals bring this solution, like all the other 80 Smart Towers, the benefits of consistent peripherals, uniform hardware/software interfaces and a shared programming environment. What is more, the Industrial PC does not just record all the operating and error messages. Remote maintenance, diagnostics and control can also be implemented, using a telephone modem connected through its COM ports.

The Smart is blazing a new trail for automobiles, one that will set standards for decades to come. The same applies to the Smart Tower, which, with its carefully planned sensors and equipment control, and

with its high level of user-friendliness, gives a real boost to the wider spread of automatic parking systems in general.

The terminal range

With more than 80 different field bus terminals, Beckhoff now offer the maximum available modularity of digital or analogue inputs and outputs. The great advantage of these two channel and four channel field bus components is the scalable – and economical – configuration of a tailor-made field bus station. The field signals reach the higher-level automation equipment through the bus coupler, which is now available for Profibus, Interbus, CANopen, DeviceNet, ControlNet, Lightbus, Ethernet TCP/IP etc.. Other extensions open up USB applications, while in the terminals, new varieties of resistance bridge (strain gauge), and analogue signals with 16-bit resolution, complete the range on offer. All electronic terminal blocks are, with a width of 12 mm, mechanically equivalent to a double 6 mm terminal. The dimensions of 68 mm x 100 mm mean that the external form of the bus coupler fits the measurements of the terminal box with technical perfection. An informative connection panel having

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LEDs for status display, push-in contact labelling and removable labelling areas ensures clarity in practice. The two-wire and three-wire conductors, with an additional connection for a protective conductor, make it possible to wire sensors and actuators directly.

The new BusBox products represent an extension to the familiar terminal blocks. The compact, robust and economically priced modules, built to protection class IP 67, are designed for direct fitting to machines, and widen the spectrum of application of the familiar Beckhoff bus terminals. The small, new 170 mm x 30 mm BusBox modules are only 27 mm high. The product range is proof against dirt and water. It can be used with any mix of signals, and so can be ideally adapted to extremely varied requirements.

The presentation towers from NuBbaum are now offered for other types of saloon car (the NuBbaum CAR Tower). Beckhoff bus terminal technology is used here again.

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